Certified Translation of JP 2003-039084

DECLARATION

I, Keiichi IIZUKA, a national of Japan, c/o Asamura Patent Office of 331-340, New Ohtemachi Building, 2-1, Ohtemachi-2-chome, Chiyoda-ku, Tokyo, Japan do hereby solemnly and sincerely declare:

1) THAT I am well acquainted with the Japanese language and English language, and

2) THAT the attached is a full, true, accurate and faithful translation into the English language made by me of Japanese Patent Application No. 2003-039084.

The undersigned declares further that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001, of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed this 20th day of October, 2006.

Keiichi IIZUKA

2003-039084

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[Title of the invention] ELECTRONIC CIRCUIT DEVICE

[Claims]

[Claim 1]

An electronic circuit device comprising,

an electronic circuit element,

a substrate on which the electronic circuit element is mounted,

a lead frame arranged to face to the substrate,

an external connection terminal electrically connected to the electronic circuit element and electrically connected to an external, and

a sealing resin sealing at least the electronic circuit element and the substrate,

characterized in that a width of the lead frame is smaller than a width of the substrate.

[Claim 2]

An electronic circuit device comprising,

an electronic circuit element,

a substrate on which the electronic circuit element is mounted,

a lead frame arranged to face to the substrate,

an external connection terminal electrically connected to the electronic circuit element and

electrically connected to an external, and

a sealing resin sealing at least the electronic circuit element and the substrate,

characterized in that the lead frame and the external connection terminal have regions projecting outward from the sealing resin, and

a width of an area of the lead frame in the sealing resin on an edge extending between the regions is narrower than a width of another area of the substrate facing to the area.

[Claim 3]

An electronic circuit device comprising,

electronic circuit elements,

a substrate including a ceramic on which the electronic circuit elements are mounted,

a lead frame arranged to face to the substrate and including a metal,

an external connection terminal connected electrically to the electronic circuit elements and connected electrically to an external,

a sealing resin covering the electronic circuit elements, the substrate, the lead frame and the external connection terminal,

characterized in that as seen in a thickness direction, upper ends of the electronic circuit elements are arranged to be lower than an upper end of the sealing resin,

the lead frame and the external connection

terminal have regions projecting outward from the sealing resin, and

as seen in the thickness direction, a width of an area of the lead frame overlapping the substrate on an edge extending between the regions is narrower than a width of another area of the substrate facing to the area.

[Claim 4]

The electronic circuit device according to claim 2, characterized in that the width of the lead frame is not more than 0.8 time of the width of the substrate.

[Claim 5]

The electronic circuit device according to claim 2, characterized in that the electronic circuit element includes a CPU and another IC, and as seen in a thickness direction, the lead frame overlaps the CPU.

[Claim 6]

The electronic circuit device according to claim 2, characterized in that a difference in thermal expansion coefficient between the substrate and the lead frame is smaller than a difference in thermal expansion coefficient between the substrate and the resin.

[Claim 7]

The electronic circuit device according to claim 2, characterized in that a width of another region of the lead frame at an outside of the sealing resin is wider than the width of the region of the lead frame in

the sealing resin.

[Claim 8]

The electronic circuit device according to claim 3, characterized in that a width of another region of the lead frame at an outside of the sealing resin is wider than the width of the overlapping area of the lead frame.

[Detailed explanation of the invention]

[0001]

[Technical field relating to the invention]

The invention relates to an electronic circuit device.

[0002]

[Background art]

Referring to an electronic circuit device in which an electronic circuit is sealed with a resin such as epoxy, a structure in which the electronic circuit element and a metallic lead frame connected to each other is received by a resin to become one-piece, is disclosed.

[Patent document 1]

JP-hei-9-232341-A

[Patent document 2]

JP-2000-183241-A

[Non-patent document 1]

ASAO NISHIMURA, SUEO KAWAI, AND GEN MURAKAMI, "Effect of Lead Frame Material on Plastic-Encapsulated IC Package

Cracking Under Temperature Cycling", IEEE TRANSACTION ON COMPONENT, HYBRIDS, AND MANUFACTURING TECHNOLOGY, VOL.12, DECEMBER, 1989, pp638-645

[0003]

[Problem to be solved by the invention]

The inventors, as a result of considering the structure, found that the structure of the prior art is not sufficient for effectively restraining a removal or crack between the resin and the lead frame from being caused by a stress at an end of the lead frame.

[0004]

If the removal between the resin and the lead frame and the crack of the resin formed by the stress caused by the difference in thermal expansion coefficient between the resin and the element such as the lead frame, electronic circuit device or the like during a heat cycle test, a humidity resistance of the electronic circuit device is deteriorated to cause a breakdown pf the electronic circuit device.

For example, a case in which the electronic circuit element made of silicon and the lead frame made of an alloy are joined with an adhesive and is received by a resin to form one-piece, is considered. If the heat cycle test of -55-150°C is brought about on this electronic circuit device, there is a provability of that the removal and crack shown in fig. 1 of the above non patent document 1 occurs. The resin is softened at a high temperature of 150°C to make the stress zero. The

resin has a greater thermal expansion coefficient in comparison with the silicon and 42 alloy to cause a relatively large contraction value and become hard at a low temperature so that a tension stress in a direction parallel to a surface of the lead frame is generated at the low temperature of -55°C. The stress is concentrated at the end of the lead frame to cause the removal between an interface between the resin and the lead frame and the crack starting from the end of the lead frame. When the stress is generated repeatedly during the heat cycling test, the removal or crack grows gradually so that the crack reaches a surface of the resin. This crack occurs along the substantially whole of the end of the lead frame. If the crack reaches the surface of the resin, the humidity resistance of the electronic circuit device is deteriorated to cause the breakdown of the electronic circuit device.

[0005]

The object of the invention is to provide an electronic circuit device in which a removal between a resin and a lead frame and a crack of the resin is prevented from being caused by a stress.

[0006]

[Means for solving the problem]

For solving the problem, it relates to an electronic circuit device comprising, an electronic circuit element, a substrate on which the electronic circuit element is mounted, a lead frame arranged to

face to the substrate, an external connection terminal electrically connected to the electronic circuit element and electrically connected to an external, and a sealing resin sealing at least the electronic circuit element and the substrate, characterized in that a width of the lead frame is smaller than a width of the substrate.

[0007]

Further, as a concrete structure, it is an electronic circuit device comprising, an electronic circuit element, a substrate on which the electronic circuit element is mounted, a lead frame arranged to face to the substrate, an external connection terminal electrically connected to the electronic circuit element and electrically connected to an external, and a sealing resin sealing at least the electronic circuit element and the substrate, characterized in that the lead frame and the external connection terminal have regions projecting outward from the sealing resin, and a width of an area of the lead frame in the sealing resin on an edge extending between the regions is narrower than a width of another area of the substrate facing to the area.

[0008]

Accordingly, the electronic circuit device in which the removal between the resin and the lead frame and the crack of the resin are prevented from being caused by the stress, can be provided.

[0009]

Preferably, the width of the lead frame is not more than 0.8 time of the width of the substrate.

[0010]

Further, preferably, the width of a region of the lead frame outside of the sealing resin is wider than the width of a region of the lead frame in the sealing resin.

[0011]

[Embodiment]

A first is shown in figs. 1-5. Fig. 3 is a front view of the embodiment of the electronic circuit device of the invention. Fig. 4 is a plan view, and fig. 5 is a side view. Fig. 1 is a lower view showing a situation in which a resin is removed, and fig. 2 is a front view as a cross sectional view. In these drawings, a ceramic substrate 2 on which electronic circuit elements 1 are mounted is adhered to a lead frame 3 by an resin adhesive 12, and the electronic circuit elements 1 are electrically connected to metallic leads 4 and aluminum wires 5 and are sealed by a resin 6. An end of the lead frame 3 projects outward from the resin 6 in such a manner that a heat energy generated by the electronic circuit elements 1 is radiated to an outside of the electronic circuit device through the metallic lead frame. In the electronic circuit device of the invention in which a shape of the lead frame is shown on the lower view of the electronic circuit device of the invention as fig. 1 and the front

view of fig. 2 as AA cross section (fig. 1), as shown in fig. 2, a width W1 of an area of the lead frame between parts of sides of the lead frame projecting outward from the resin major parts (more than half) of whose sides are sealed by the resin is smaller than a width W2 of the substrate. Further, a region of the lead frame adhered to the substrate is arranged inside the substrate.

[0012]

A part of the lead frame 3 and a part of the substrate 2 facing to each other are adhered by the resin adhesive 12 to each other over the whole of a common area in which the part of the lead frame 3 and the part of the substrate 2 facing to each other. The lead frame projects from a pair of sides of the sealing resin opposed to each other, leads project from another pair of sides of the sealing resin, and a distance between sides of the lead frame opposed to each other and parallel to the sides of the resin from which the leads project is smaller than a distance between sides of the substrate opposed to each other and parallel to the sides of the resin.

[0013]

Concretely, for example, the resin is formed in such a manner that, as seen in a thickness direction, an upper end of an electronic circuit element 1 is arranged at a lower side than an upper end of a resin 6, and a lower end of a lead frame 3 is at an upper side

than a lower end of the resin 6.

Leads 4 as external connection terminals and the lead frame 3 have regions projecting outward from the sealing resin, and it is preferable that as seen in the thickness direction, a width of an area of the lead frame 3 overlapping a substrate 2 between sides of the lead frame 3 joining the projecting regions thereof is narrower than a width of an area of the substrate 2 facing to the lead frame.

[0014]

The ceramic substrate 2 has a coefficient of linear expansion of about $7 \times 10^{-6}K^{-1}$, and the lead frame 3 is a stack of a pair of Cu plates and a low coefficient of linear expansion plate of Inver between the Cu plates and has a coefficient of linear expansion of about $8\text{-}10 \times 10^{-6}K^{-1}$. The resin 6 is an epoxy resin or the like with a coefficient of linear expansion of about $15 \times 10^{-6}K^{-1}$.

[0015]

A difference in coefficient of linear expansion between the substrate and lead frame is smaller than a difference in coefficient of linear expansion between the substrate and resin, or a difference in coefficient of linear expansion between the substrate and lead frame is smaller than a difference in coefficient of linear expansion between the lead frame and resin.

[0016]

A structure of a comparative sample is described below. A resin sealing structure for mounting the ceramic substrate 2 of large size connected to the electronic circuit elements 1 is shown in Figs. 20-22. The ceramic substrate 2 adhered to the lead frame 3 by the resin adhesive 12 is connected to the metallic leads 4 and the aluminum wires 5, and sealed by the resin 6. The width W1 of the lead frame 3 is larger than the width W2 of the substrate 2.

[0017]

Since the electronic circuit device is greater than the above electronic circuit device, a heat deformation of the resin is great to increase a thermal stress so that a removal and crack of the resin occurs easily. Since the ceramic substrate 2 is great in this electronic circuit device, an excessive thermal stress is generated in an adhesive 12 to cause a removal of the adhesive 12 when the ceramic substrate 2 and the lead frame is different in linear expansion coefficient.

[0018]

For preventing the removal, a material of low thermal expansion coefficient similar to that of the substrate 2 is used as a material of the lead frame 3. On the other hand, the resin may be adjusted in linear expansion coefficient by mixing an organic material such as epoxy or the like of great linear expansion coefficient with grains of low thermal expansion such as SiO_2 or the like, but the resin has the thermal expansion

coefficient significantly greater than the lead frame.

[0019]

A metal of great thermal conductivity is used for the lead frame to radiate a heat energy generated by the electronic circuit element 1 through thermal conduction to an outside of the resin. Therefore, an etching process or punching press process suitable for the metal is used to form a shape of the lead frame. Fig. 19(1) shows schematically a shape of cross section of an end of lead frame formed by punching 42 alloy 7, and fig. 19(2) shows a shape of cross section of the end of the lead frame formed by etching a stack of Cu 10 and Inver 11. In Fig. 19a corresponding a case in which the punching is performed from an upper side to a lower side in the drawing, a protrusion is formed at a lower part of the end of the lead frame. In fig. 19(2), the protrusions are formed at upper and lower parts of the end of the lead frame. If a homogeneous material is etched, the protrusions shown in fig. 19(2) are formed. A removal of the protrusion on the end of the lead frame increases a cost for production, so that it is not performed actually. Therefore, a stress concentration generated at the end of the lead frame received by the resin is increased by protrusion so that the removal between the resin and the lead frame and the crack of the resin easily occur from the protrusion. Against this, the crack is restrained by the embodiment of the invention in which the substrate of sintered body us

arranged outside the end.

[0020]

The stress in the vicinity of the end of the lead frame generated by temperature decrease from 150°C to -55°C in the temperature cycle test for each of the electronic circuit device as the comparative sample shown in figs. 20-22 and the electronic circuit device of the invention shown in figs. 1-5 was obtained with a stress analysis by a finite element method. The analysis was brought about by keeping the width W2 of the substrate of each of the electronic circuit device as the comparative sample shown in figs. 20-22 and the electronic circuit device of the invention shown in figs. 1-5 constant and by changing the width W1 of the lead frame. Fig. 6 shows briefly these stresses in the vicinity the end of the lead frame. Fig. 6 is a relationship between a ratio W1 / W2 between the width W1 of the lead frame and the width W2 of the substrate and the stress in the vicinity of the end of the lead frame formulated on the base of the stress obtained when W1 / W2 = 1. From fig. 6 in which the stress decreases in accordance with decrease of W1 / W2, and particularly the change of stress is abrupt when W1 / W2 ≒ 1, it is preferable that W1 / W2 is not more than 1.

[0021]

In the electronic circuit device as the comparative sample shown in figs. 20-22, the whole of the surface of the substrate is adhered to the lead

frame to accelerate a heat discharge of the heat energy generated by the electronic circuit element 1 from the lead frame. In the electronic circuit device as the comparative sample, as shown in fig. 21, the width W1 of the lead frame is greater than the width W2 of the substrate. As a hard consideration, it was found that a ratio between the width W1 of the lead frame and the width W2 of the substrate has a significant effect on the stress of the resin in the vicinity of the lead frame, and the stress of the resin in the vicinity of the lead frame can be decreased by making the width W1 of the lead frame smaller than the width W2 of the substrate. According to the invention, on the basis of this finding, the removal between the resin and the lead frame and the crack of the resin caused by the stress of the resin in the vicinity of the end of the lead frame in the electronic circuit device as the comparative sample are restrained.

[0022]

Incidentally, it is preferable for obtaining sufficient effect that W1 / W2 is significantly small, for example, not more than 0.8. Further, if a plurality of the electronic circuit elements are included and CPU and the other IC are included, it is preferable that the lead frame 3 overlaps the CPU as seen in the thickness direction. For example, an outer periphery of the CPU overlaps. When a driver IC is included, it is preferable that the lead frame overlaps the driver IC.

[0023]

For preventing the removal, a material of low thermal expansion coefficient similar to that of the substrate 2 is used as a material of the lead frame 3. On the other hand, the resin may be adjusted in linear expansion coefficient by mixing an organic material such as epoxy or the like of great linear expansion coefficient with grains of low thermal expansion such as SiO_2 or the like, but the resin has the thermal expansion coefficient significantly greater than the lead frame.

[0024]

A metal of great thermal conductivity is used for the lead frame to radiate a heat energy generated by the electronic circuit element 1 through thermal conduction to an outside of the resin. Therefore, an etching process or punching press process suitable for the metal is used to form a shape of the lead frame. Fig. 19(1) shows schematically a shape of cross section of an end of lead frame formed by punching 42 alloy 7, and fig. 19(2) shows a shape of cross section of the end of the lead frame formed by etching a stack of Cu 10 and Inver 11. In Fig. 19a corresponding a case in which the punching is performed from an upper side to a lower side in the drawing, a protrusion is formed at a lower part of the end of the lead frame. In fig. 19(2), the protrusions are formed at upper and lower parts of the end of the lead frame. If a homogeneous material is etched, the protrusions shown in fig. 19(2) are formed.

A removal of the protrusion on the end of the lead frame increases a cost for production, so that it is not performed actually.

[0025]

Therefore, a stress concentration generated at the end of the lead frame received by the resin is increased by protrusion so that the removal between the resin and the lead frame and the crack of the resin easily occur from the protrusion. Against this, the crack is restrained by the embodiment of the invention in which the substrate of sintered body us arranged outside the end.

[0026]

The formed shape of the end of the lead frame is described above, but the substrate different in producing method has a shape of an end thereof different from the shape of the end of the lead frame. Since the substrate is made of ceramic, the substrate is formed by forming a paste as a mixture of ceramic material powder and solvent to have a sheet shape and sintering it in high temperature. Therefore, the end of the substrate has necessarily a smooth shape. Therefore, a difference in linear expansion coefficient between the resin and substrate and a difference in linear expansion coefficient between the resin and lead frame are substantially equal to each other so that an average stress of the resin in the vicinity of the substrate and an average stress of the resin in the vicinity of the

lead frame are equal to each other. Although the stress is concentrated by the protrusion at the end of the lead frame to cause the interface removal and the crack of resin, the end of the substrate has the smooth shape to prevent the stress concentration to restrain the interface removal and the crack of resin.

[0027]

Figs. 7 and 8 are schematic diagrams showing a distribution of the stress at the end of the lead frame in each of the electronic circuit device of the comparative sample and the electronic circuit device of the invention. Using these drawings, a reason of the effect by the width W1 of the lead frame and the width W2 of the substrate applied to the stress in the vicinity of the end of the lead frame is considered. The difference in thermal expansion between the resin and the substrate and difference in thermal expansion between the resin and the lead frame in a direction parallel to the surfaces of the substrate and the lead frame causes mainly the stress in the resin. The substrate and lead frame have the substantially identical linear expansion coefficient to generate a small value of the stress therebetween. When a thermal cycle test within the temperature range between -55°C and 150°C is applied to the electronic circuit devices, the stress becomes substantially zero at 150°C because the resin is softened. The resin becomes hard at -55°C, and the resin contracts more greatly in the direction

parallel to the surface of the lead frame and the substrate in comparison with the substrate and the lead frame because the coefficient of linear expansion of the resin is significantly greater than that of each of the substrate and lead frame. There is a provability of that the contraction causes the hearing stress at the interface between the resin and the substrate and the resin and the lead frame. Since the lead frame and the substrate generates the substantially identical thermal expansion, the shearing stress at the interface is maximum at farthest one of the end of the substrate and the end of the lead frame from centers of the substrate and the lead frame, and decreases in accordance with decrease of a distance from centers of the substrate and the lead frame. The distribution of the shearing stress 14 is shown in figs. 7 and 8.

[0028]

In the comparative sample as shown in Fig. 7, the maximum shearing stress generated at the end of the lead frame is greater that the maximum shearing stress generated at the end of the substrate, because the end of the lead frame is farther than the end of the substrate from the centers. In the electronic circuit device as shown in Fig. 8, the maximum shearing stress generated at the end of the lead frame 3 is smaller than the maximum shearing stress generated at the end of the substrate, because the end of the substrate is farther than the end of the lead frame. Since the shearing

stress at the end of the lead frame is decreased in the electronic circuit device of the invention, the removal and crack at the end of the lead frame as a problem of the electronic circuit device of the comparative sample is restrained. Incidentally, the stress at the end of the substrate of the electronic circuit device of the invention is increased by making the shape of the end of the substrate smooth as describe above, such increase of the stress restrains the removal and crack at the end of the substrate.

[0029]

The end of the lead frame projects from the resin to radiate the heat energy of the electronic circuit element 1 from the resin with thermal conduction through the lead frame. In this embodiment, its width is slightly narrower than that of the substrate so that a performance for radiating the heat energy of the electronic circuit element 1 from the resin is decreased, but since the significant effect for decreasing stress is obtainable by slight decrease of W1/W2 as shown in fig. 6, the width of the lead frame does not need to be decreased to cause a significant decrease of heat radiating performance.

[0030]

A second embodiment of the electronic circuit device of the invention is shown in Figs. 9-13. Fig. 12 is a front view of the embodiment of the electronic circuit device of the invention, fig. 11 is a plan view

and fig. 13 is a side view. Fig. 9 is a lower view of the electronic circuit device of the invention from which the resin is removed, and fig. 10 is a plan view as AA cross section (fig. 9).

[0031]

The second embodiment has basically a structure similar to the structure of the first embodiment, but has a distinctive feature of that a width of a part of the lead frame projecting outward from the resin is greater than another part of the lead frame in the resin. In other words, the width of the part of the lead frame projecting outward from the resin is greater than another part of the lead frame facing to the substrate. In these drawings, the ceramic substrate 2 of large size connected to the electronic circuit elements 1 is adhered by the adhesive 12 to the lead frame 3, connected to the metallic leads 4 and aluminum wires 5, and sealed by the resin 6. Further, the part of the lead frame 3 projects from the resin 6 to radiate the heat energy generated by the electronic circuit elements 1 to the outside through the substrate 8 and the lead frame 3.

The arrangement of the elements is not differentiated from the first embodiment of the electronic circuit device of the invention. Since the width of the part of the lead frame 3 projecting from the lead 3 is greater than the width of the another part thereof overlapping thee substrate in this embodiment,

the heat radiating performance from the lead frame is increased in addition to the above effect.

[0032]

A third embodiment of the electronic circuit device of the invention is shown in Figs. 14 and 15. Fig. 14 is a lower view of the embodiment of the electronic circuit device of the invention, and fig. 15 is a plan view as AA cross section (fig. 14). The basis structure has the arrangement disclosed in the fourth embodiment. In the third embodiment, the width of the lead frame projecting from the resin increases gradually to further improve the heat radiating performance from the lead frame. Further, the width of the lead frame projecting from the resin increases gradually to restrain an excessive stress from being caused by an abrupt change of the shape of the lead frame.

[0033]

A fourth embodiment of the electronic circuit device of the invention is shown in Figs. 16 and 17. Fig. 16 is a lower view of the embodiment of the electronic circuit device of the invention, and fig. 17 is a plan view showing AA cross section (fig. 16). The basis structure includes the arrangement disclosed as the first embodiment. In these drawings, the ceramic substrate 2 of large size connected to the electronic circuit elements 1 is adhered by the adhesive 12 to the lead frame 3, connected to the metallic leads 4 and aluminum wires 5, and sealed by the resin 6. In the

fourth embodiment, the lead frame projecting from the lead frame has a constriction of width at a central area between two sides of the resin. This embodiment is suitable for a case where the heat energy generated by the electronic circuit element is not significantly great. Therefore, although the heat radiating performance through the lead frame is low, the following merits are obtainable. During an abrupt heating process such as fixing the electronic circuit device to a printed substrate with soldering, the lead frame of high thermal conductivity increases in temperature abruptly to generate the thermal expansion so that the thermal stress is caused in the resin in the vicinity of a root of the projecting part of the lead frame to form the crack of the resin. In this embodiment, since the width of the part of the lead frame projecting from the resin is narrower than the another part of the lead frame and an end side region of the projecting part thereof, the thermal stress of the resin in the vicinity of the root of the projecting part of the lead frame is prevented from being increased rapidly by the abrupt increase of temperature of the lead frame during the abrupt heating process. Therefore, the reliability against the crack caused by the thermal stress is improved.

[0034]

[Advantage of the invention]

According to the invention, the electronic circuit device in which the removal between the resin

and the lead frame and the crack of the resin caused by the stress are prevented, is provided.

[0035]

[Brief explanation of the drawings]

[Fig. 1]

a lower view of first embodiment of electronic circuit device of the invention

[Fig. 2]

a front view of first embodiment of electronic circuit device of the invention

[Fig. 3]

a plan view of first embodiment of electronic circuit device of the invention

[Fig. 4]

a front view of first embodiment of electronic circuit device of the invention

[Fig. 5]

a side view of first embodiment of electronic circuit device of the invention

[Fig. 6]

diagram showing a relationship between a ratio between lead frame width and substrate width of the invention and a stress in resin at end of lead frame

[Fig. 7]

schematic view showing a stress distribution in the vicinity of end of lead frame of electronic circuit device of comparative sample

[Fig. 8]

schematic view showing a stress distribution in the vicinity of end of lead frame of electronic circuit device of the invention

[Fig. 9]

a lower view of second embodiment of electronic circuit device of the invention

[Fig. 10]

a front view of second embodiment of electronic circuit device of the invention

[Fig. 11]

a plan view of second embodiment of electronic circuit device of the invention

[Fig. 12]

a front view of second embodiment of electronic circuit device of the invention

[Fig. 13]

a side view of second embodiment of electronic circuit device of the invention

[Fig. 14]

a lower view of third embodiment of electronic circuit device of the invention

[Fig. 15]

a front view of third embodiment of electronic circuit device of the invention

[Fig. 16]

a lower view of fourth embodiment of electronic circuit device of the invention

[Fig. 17]

a front view of fourth embodiment of electronic circuit device of the invention

[Fig. 18]

cross sectional view of end of substrate

[Fig. 19]

cross sectional view of end of lead frame

[Fig. 20]

a plan view of electronic circuit device of comparative sample

[Fig. 21]

a front view of electronic circuit device of comparative sample

[Fig. 22]

a side view of electronic circuit device of comparative sample

[Description of reference numerals]

1 electronic circuit element

2 substrate

3 lead frame

4 external connection terminal

5 aluminum wire

6 resin

7 42 alloy

8 end of lead frame

9 end of substrate

10 copper

11 Inver

12 adhesive

13 crack

14 stress

15 removal

W1056MU

【書類名】 図面 [Kind of Document] Drawings

【図１】 [Fig. 1]

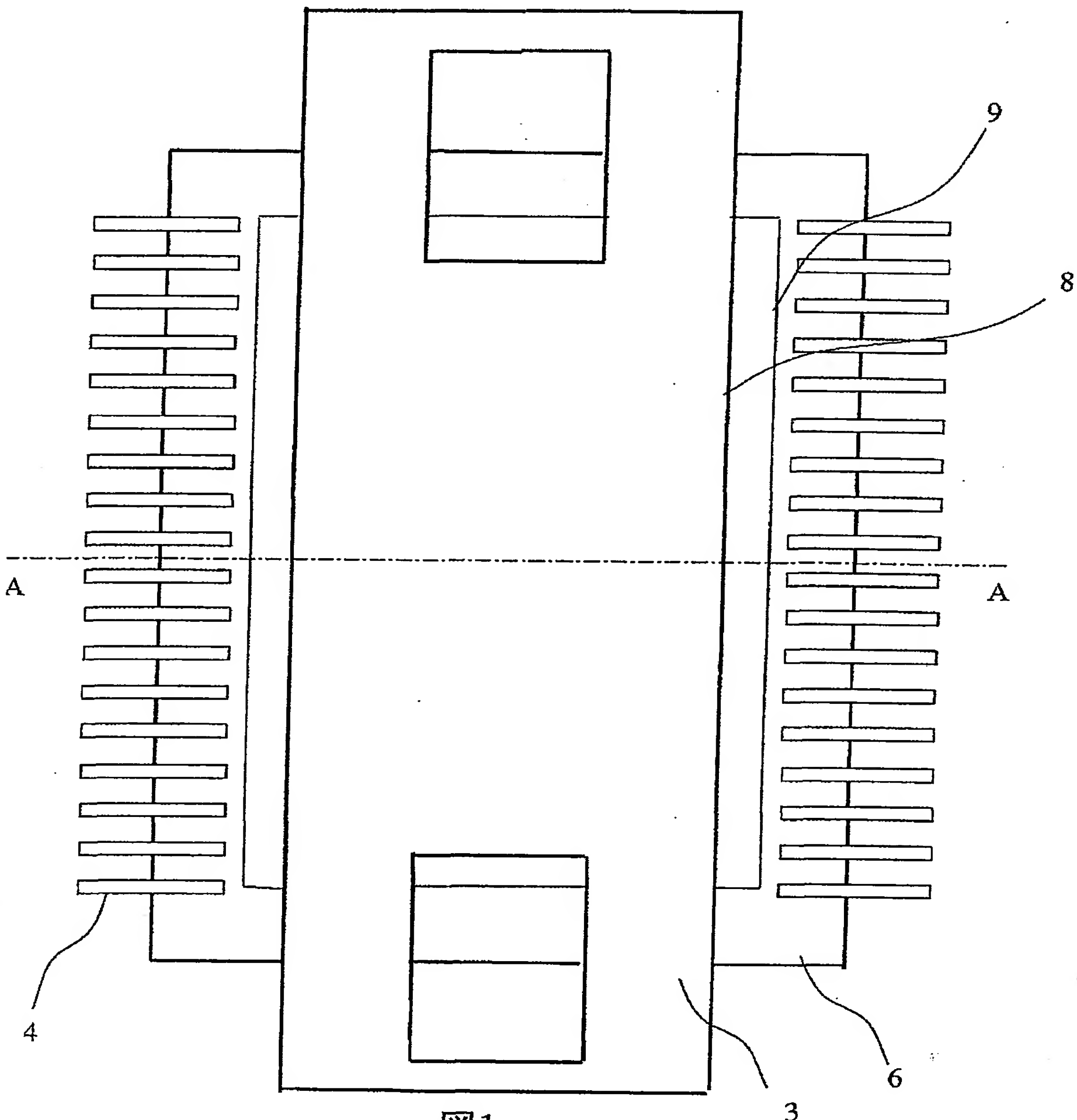


図1

【図２】
[Fig.2]

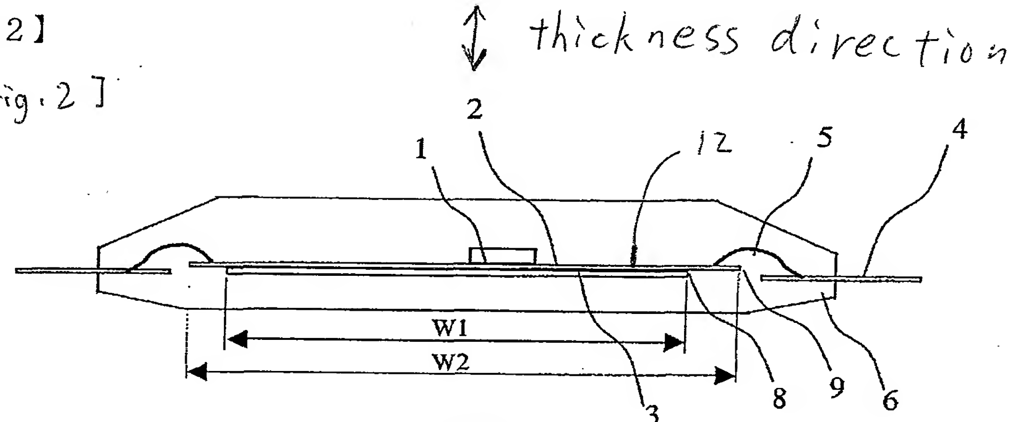


図2

【図３】

[Fig.3]

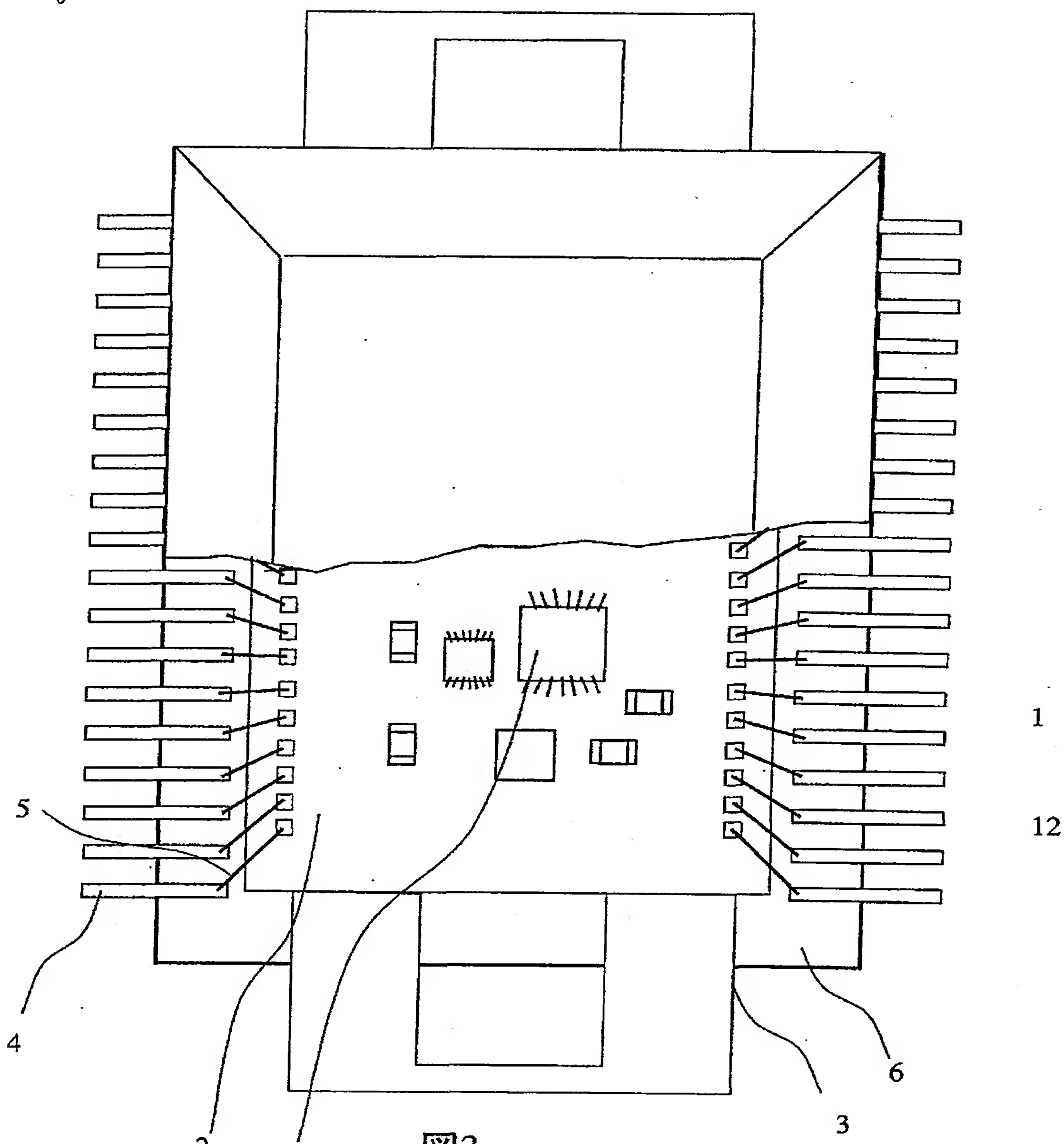


図3

【図４】

[Fig.4]

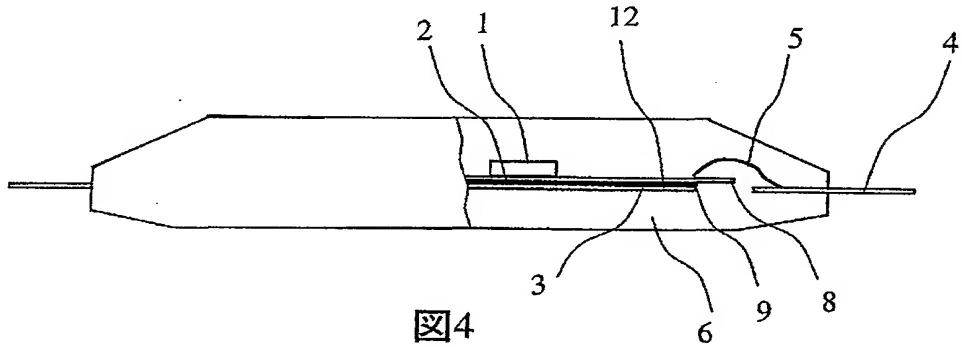


図4

【図５】

[Fig.5]

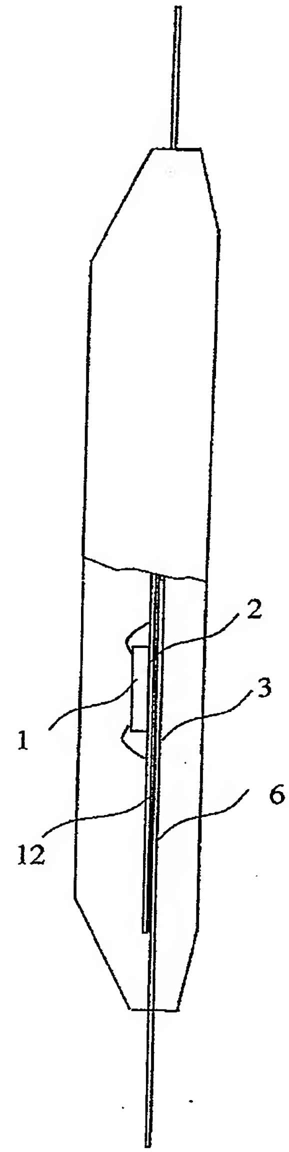


図5

【図６】［Fig.6］

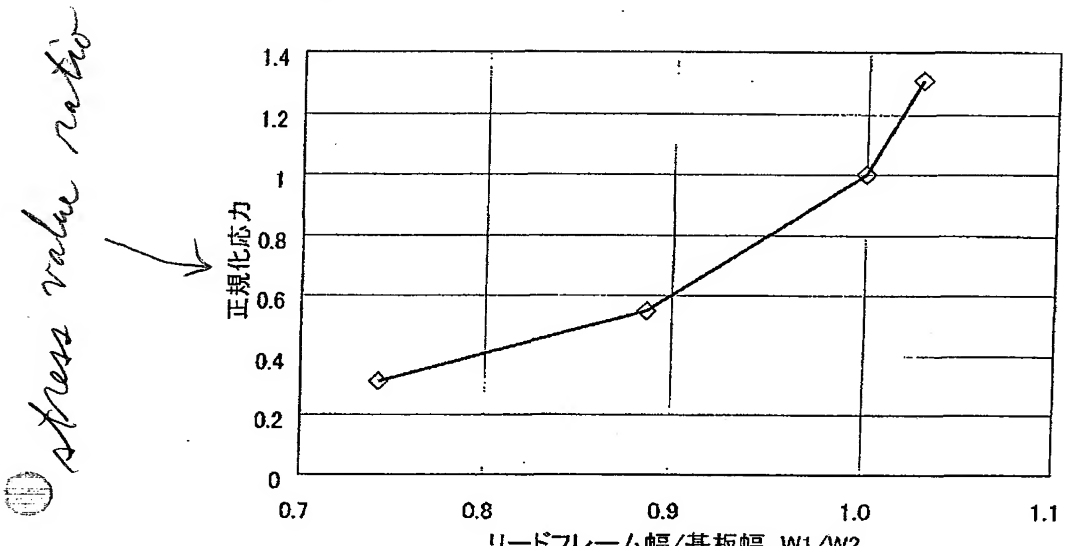


図6

【図７】［Fig.7］

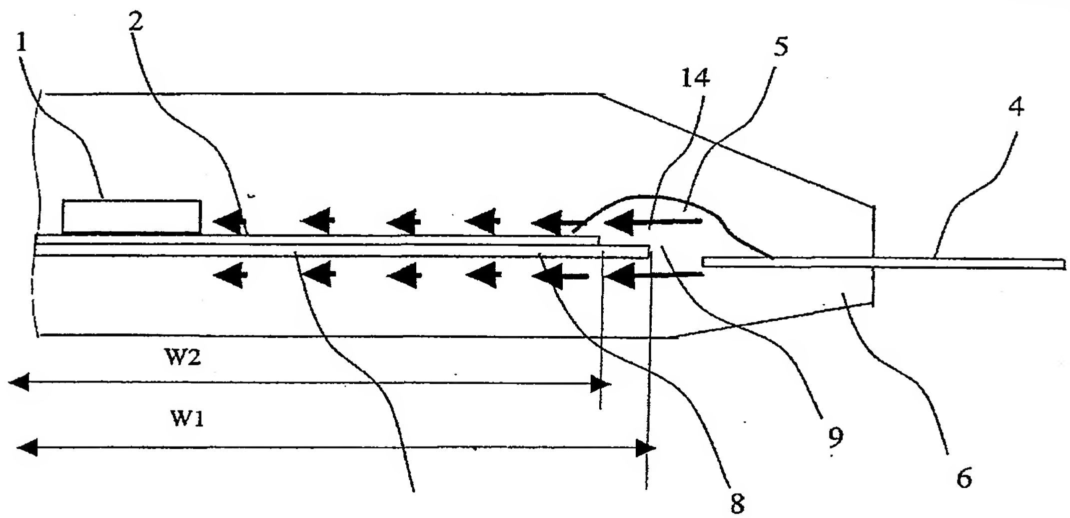


図7

【図８】［Fig.8］

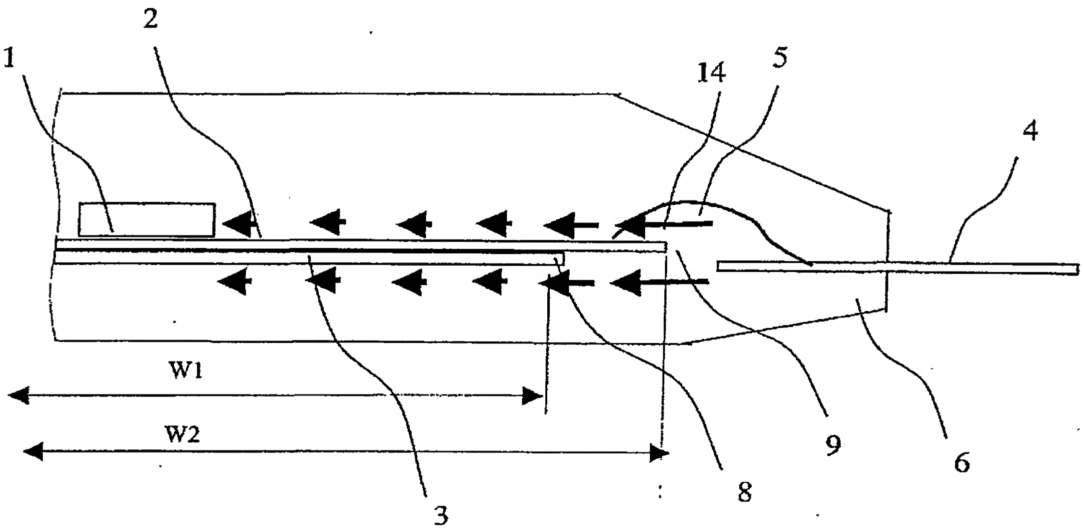


図8

【図９】 [Fig.9]

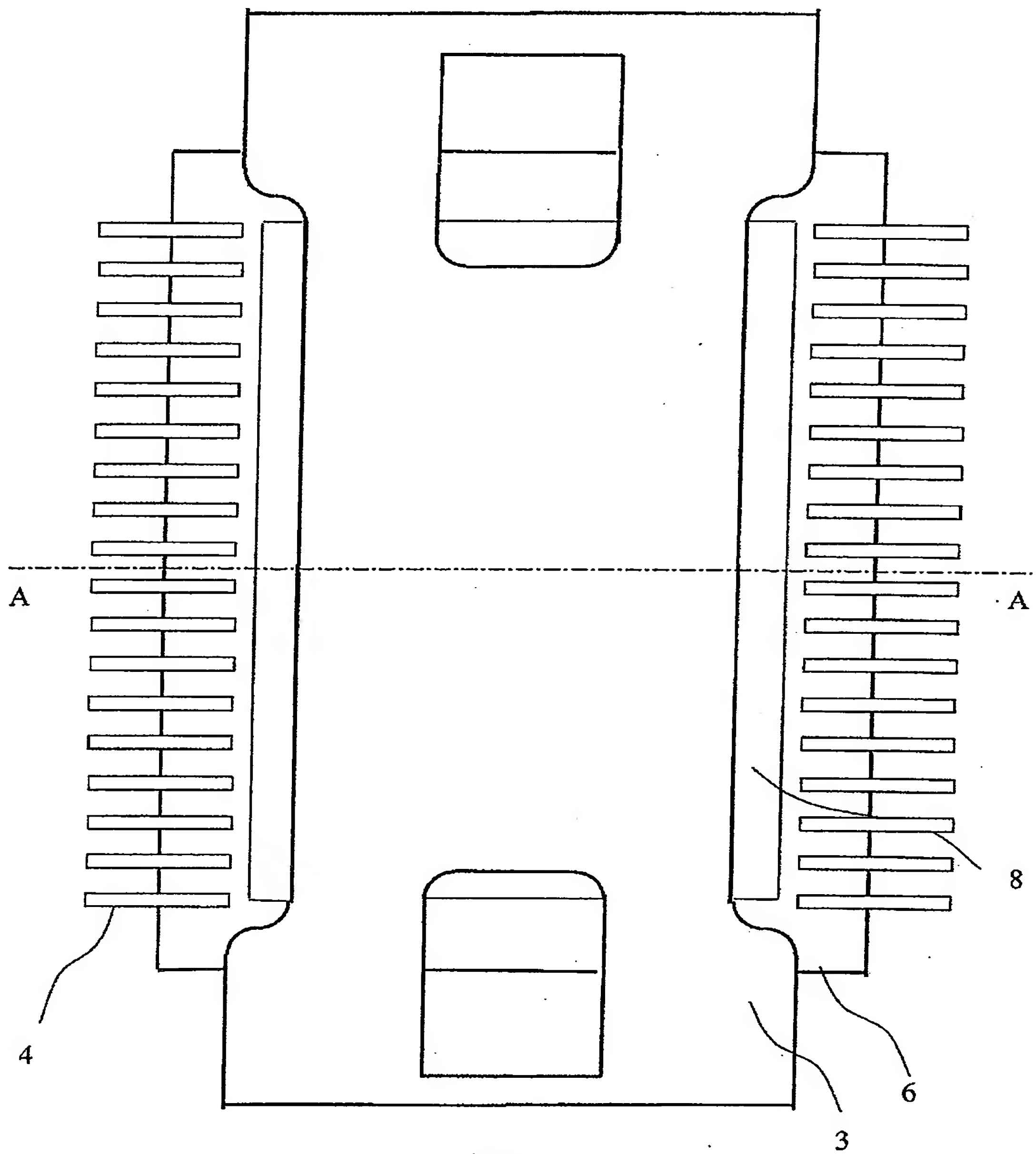


図9

【図１０】［Fig.10］

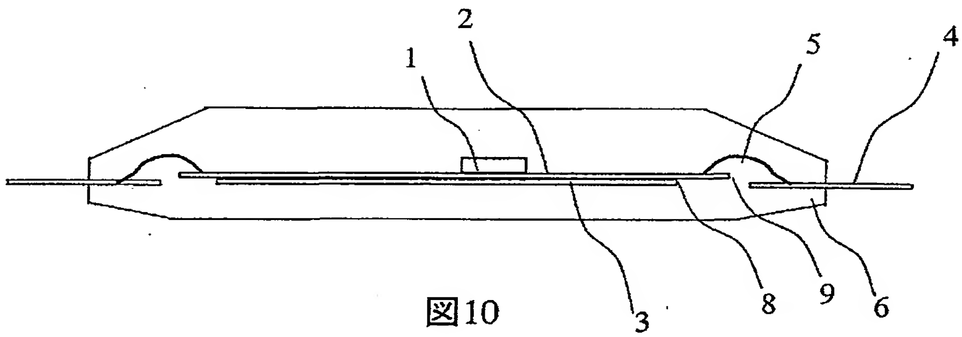


図10

【図１１】 [Fig.11]

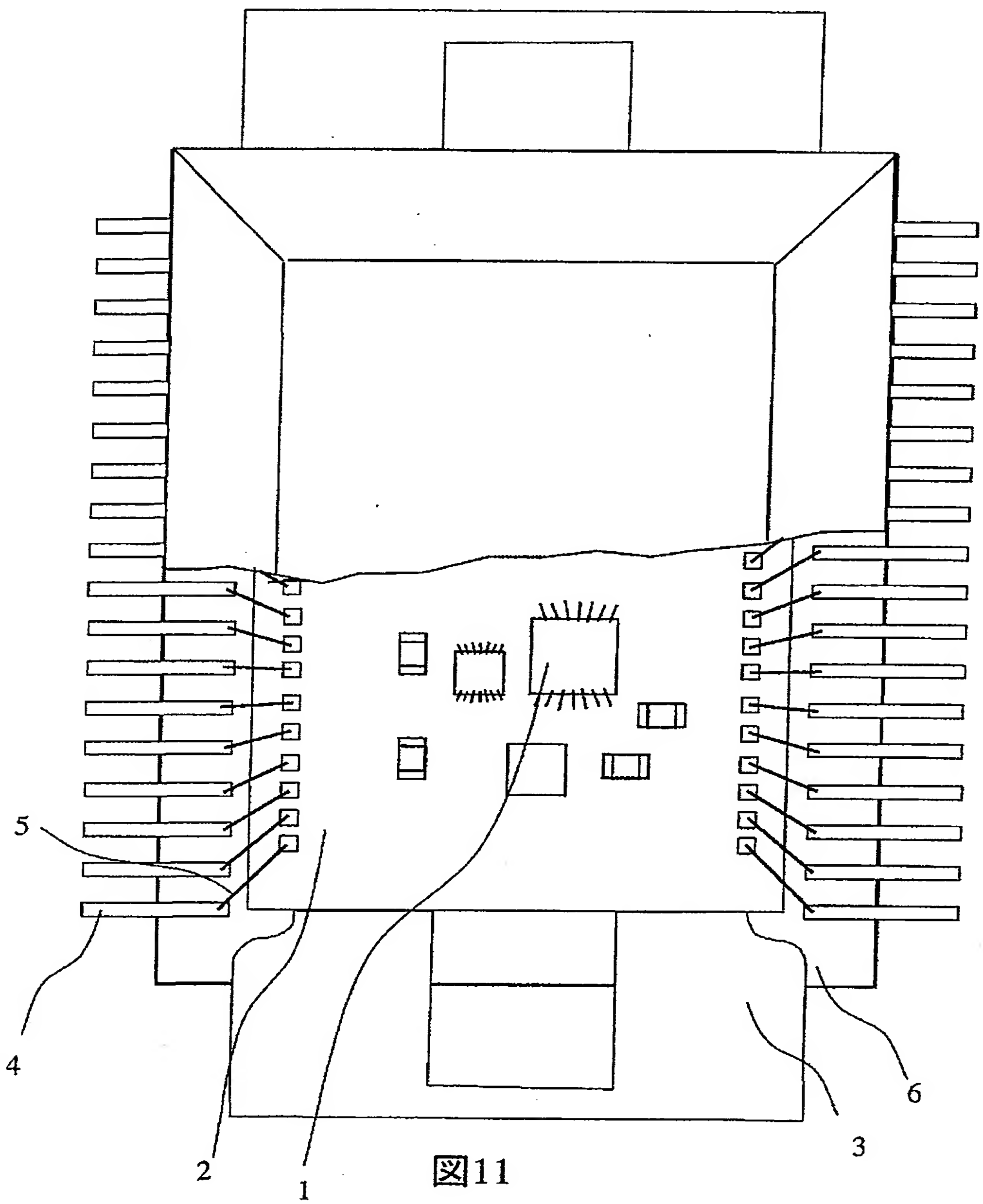


図11

【図１２】 [Fig.12]

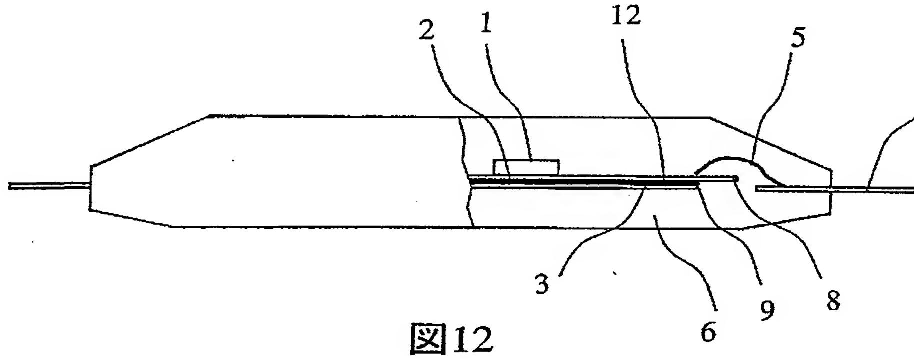


図12

【図１３】[Fig: 13]

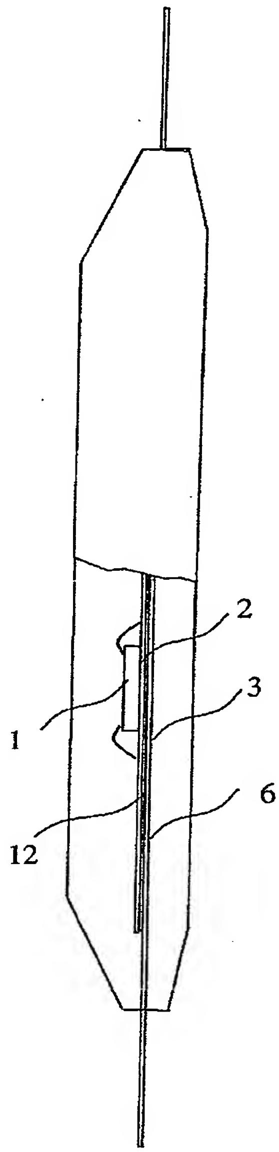


図13

【図１４】 [Fig. 14]

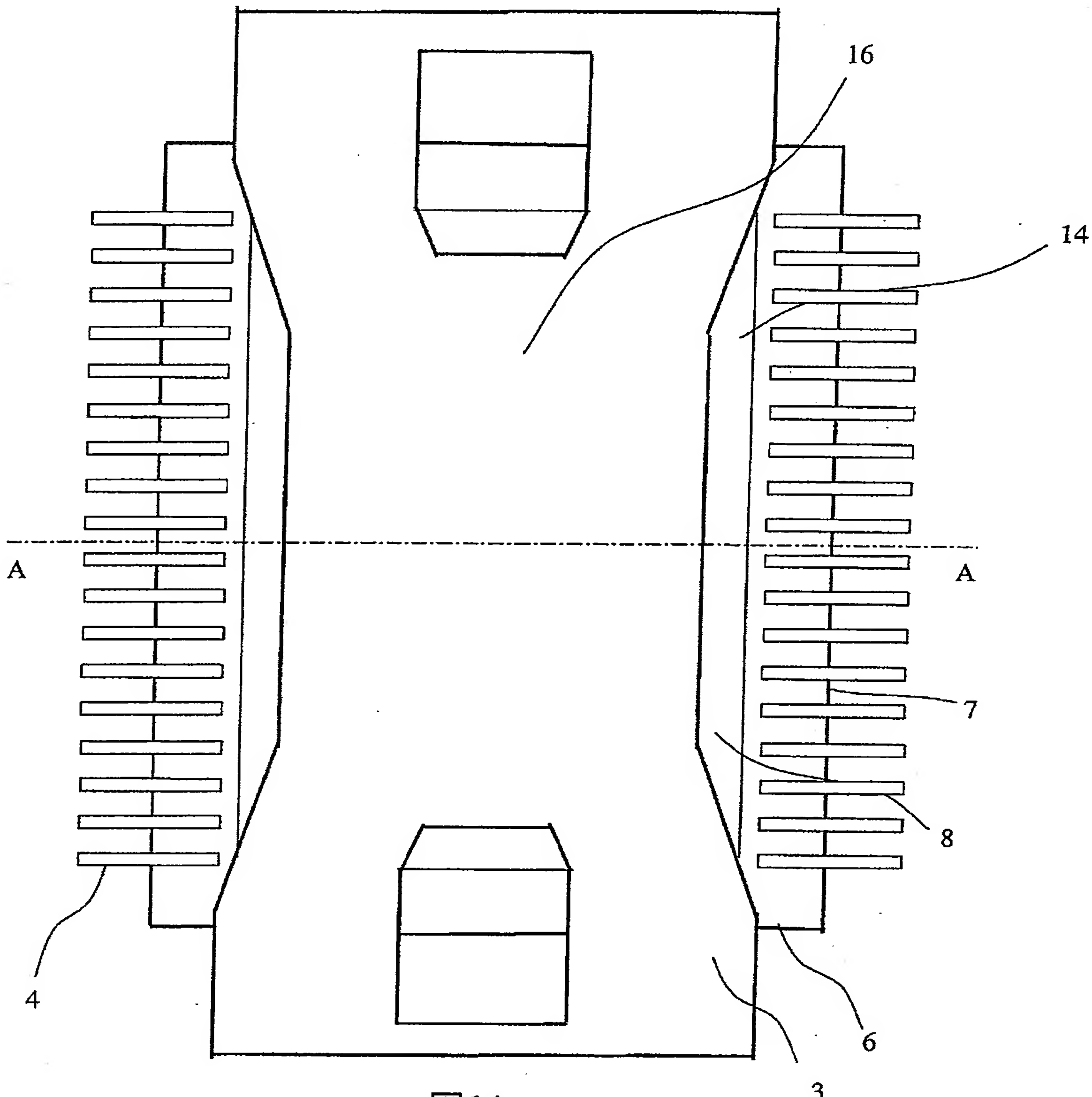


図14

【図１５】 [Fig.15]

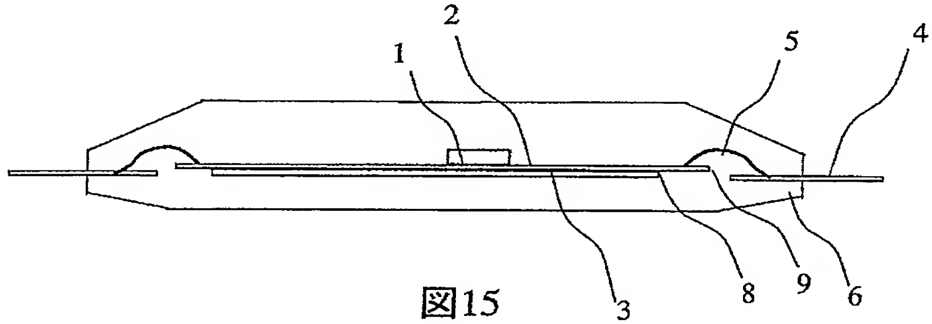


図15

【図１６】［Fig：16］

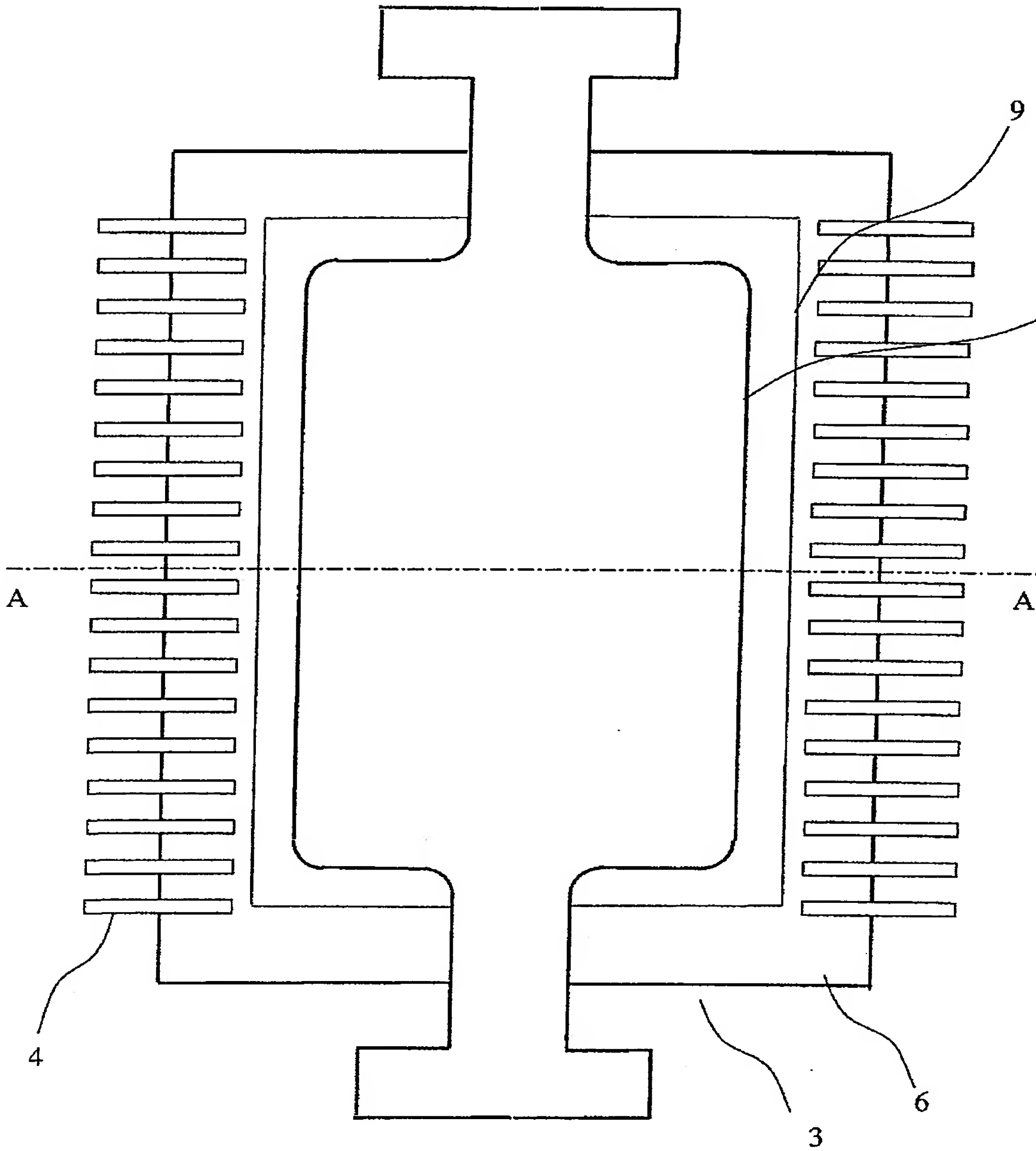


図16

【図１７】［Fig.17］

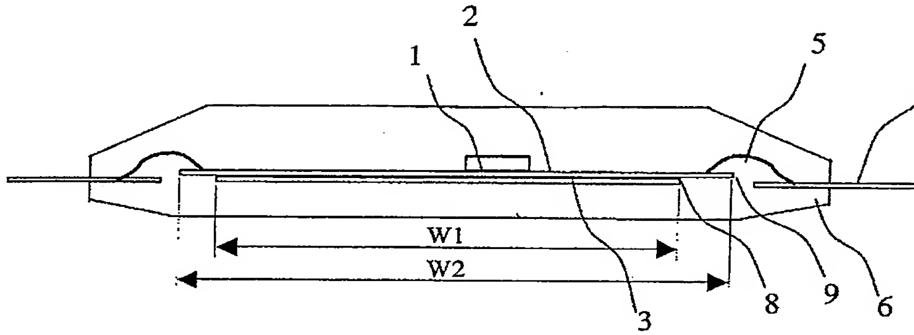


図17

【図１８】［Fig.18］

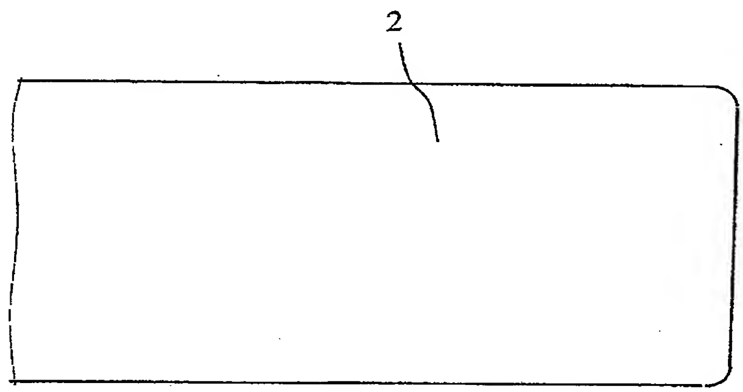
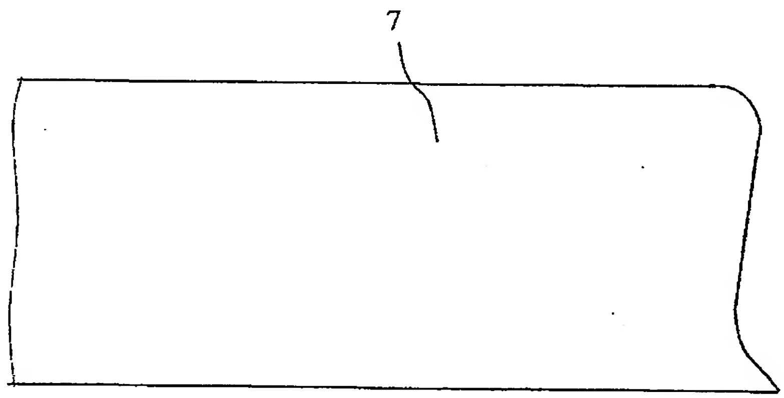
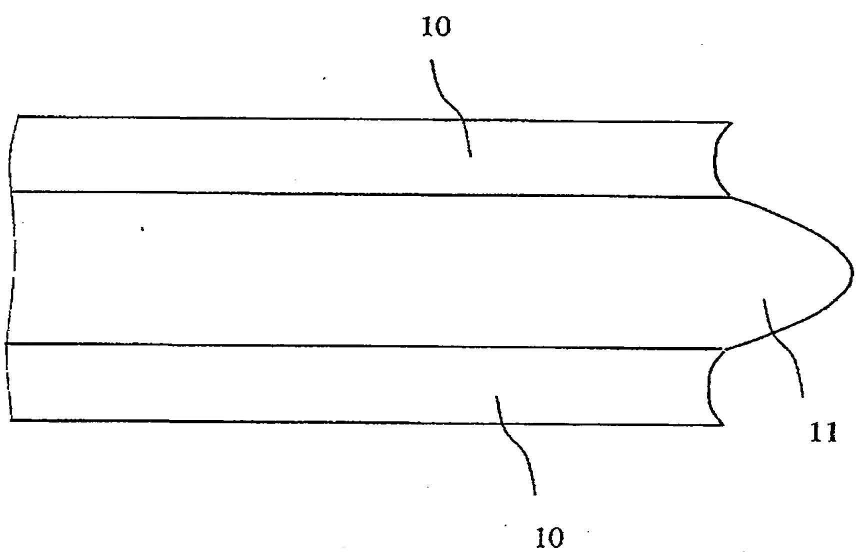


図18

【図１９】[Fig.19]



(1)



(2)

【図２０】［Fig.20］

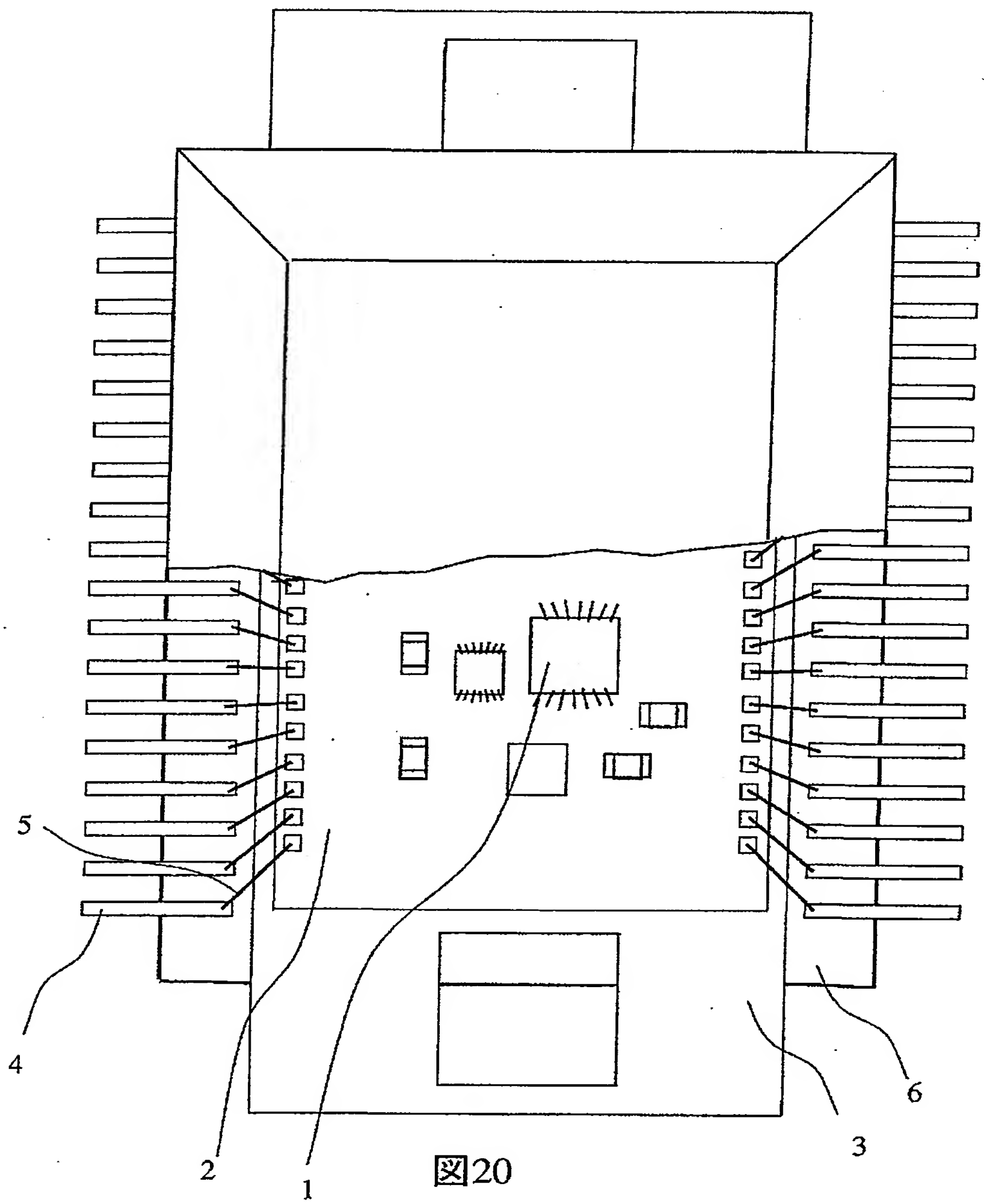


図20

【図２１】 [Fig.21]

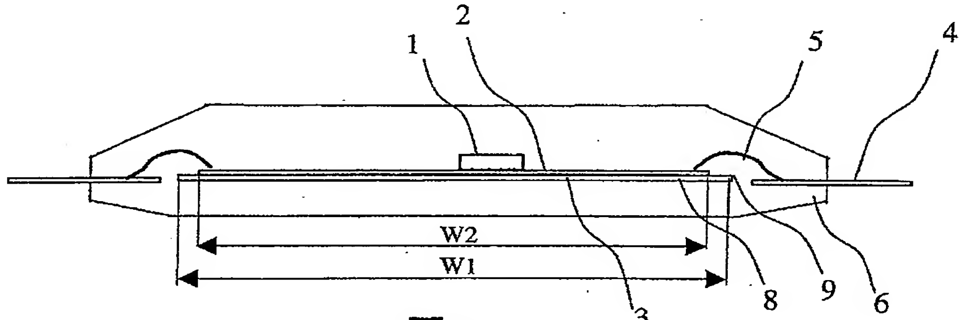


図21

【図２２】 [Fig.22]

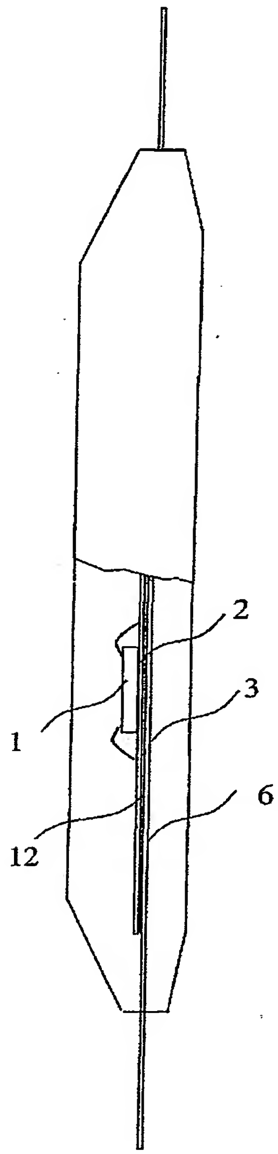


図22

[Kind of document] Abstract

[Abstract]

[Problem] An object of the invention is to provide a resin sealing structure of an electronic circuit device for preventing a removal between a resin and a lead frame and a crack of the resin.

[Solution] An electronic circuit element, a substrate on which the electronic circuit element is mounted, a lead frame facing to the substrate, an external connection terminal electrically connected to the electronic circuit element and an outside, and a sealing resin sealing the electronic circuit element and the substrate, are included, and a stress of the resin in the vicinity of an end of the lead frame is decreased by making a width of the lead frame smaller than a width of the substrate so that the removal between the resin and the lead frame and the crack of the resin caused by the resin at the end of the lead frame as the problem of the electronic circuit device are prevented.

[Selected drawing] Fig. 1